

22 April 2014

CRUISE RESULTS  
NOAA Research Vessel ***GORDON GUNTER***  
Cruise No. GU 14-01  
Winter Ecosystem Monitoring Survey

CRUISE PERIOD AND AREA

The NOAA research vessel *GORDON GUNTER* sampled at a total of 60 stations from 28 February to 9 March 2014. The cruise covered the Georges Bank and Gulf of Maine areas, and sampled approximately 38 % of a standard survey. Normally ecosystem monitoring surveys would also head south to cover the Mid-Atlantic Bight and all of Southern New England waters, but cuts in the vessel schedule only allowed enough time for sampling in the northern portion of the survey area.

OBJECTIVES

The primary objective of this cruise was to assess changing biological and physical properties which influence the sustainable productivity of the living marine resources of the Georges Bank and Gulf of Maine portions of the northeast continental shelf ecosystem.

Key parameters measured for the Ecosystem Monitoring Program included ichthyoplankton and zooplankton composition, abundance and distribution, plus water column temperature, salinity, and chlorophyll-a fluorescence. Secondary objectives of this cruise involved the following:

- ! Vertical CTD casts to within 5 meters of the bottom in Gulf of Maine deep basin areas and the Northeast Channel to provide hydrographic data detailing the incursion of Labrador Current water into this region.
- ! Sampling at the site of the liquefied natural gas (LNG) terminal east of Boston Harbor, to collect long term monitoring data.
- ! Collection of samples for the Census of Marine Zooplankton (CMarZ) genetics studies.
- ! Gathering data on trends in ocean acidification and nutrient levels by collecting seawater samples at various depths with a rosette water sampler at predetermined fixed locations.
- ! Documenting types of phytoplankton seen at varying depths by use of a fluoroprobe unit mounted on the rosette water sampler array.
- ! Determine the abundance and distribution of larval and juvenile sand lance and cod in the areas surveyed.
- ! Visual survey of birds and mammals (Appendix 1)

METHODS

The survey consisted of 60 stations at which the vessel stopped to lower instruments over the port side of the vessel from an A-frame and two conductive-wire winches. Of these, 32 were on Georges Bank and the remaining 27 stations were in the Gulf of Maine (Figure 1). All stations sampled were at randomly stratified locations except for 7 on Georges Bank and 10 stations in the Gulf of Maine which were at fixed locations for hydrography and water chemistry sampling. Seven of the fixed stations in the Gulf of Maine were also sampled for plankton. No sampling was planned for the

Southern New England and Mid-Atlantic Bight regions because there were not enough days in the vessel schedule to sample that far south. Sampling in the Gulf of Maine area was less than originally planned for the same reason but plankton sampling there was augmented by making bongo net tows at what had originally been designated rosette-only stations.

Plankton and hydrographic sampling was conducted at 49 stations by making double oblique tows using the 61-cm bongo sampler and a Seabird CTD. The tows were made to approximately 5 meters above the bottom, or to a maximum depth of 200 meters. All plankton tows were conducted at a ship speed of 1.5 – 2.0 knots. Plankton sampling gear consisted of a 61-centimeter diameter aluminum bongo frame with two 335-micron nylon mesh nets. At the randomly designated Census of Marine Zooplankton (CMarZ) stations a 20-cm diameter PVC bongo frame fitted with paired 165-micron nylon mesh nets was put on the towing wire one half meter above the Seabird CTD with a wire stop and towed together with the large aluminum bongo frame. A similar PVC bongo frame fitted with two 335 micron mesh nets was towed in a similar fashion at most of the remaining plankton stations to collect larval fish and egg samples for David Richardson at the Narragansett NEFSC lab. Two stations in the Gulf of Maine that were conducted under marginal conditions did not have either of the 20 cm bongo frames attached to avoid tangling of the multiple nets in the gusty winds. A 45-kilogram bell-shaped lead weight was attached by a 20-centimeter length of 3/8-inch diameter chain below the aluminum bongo frame to depress the sampler (Figure 2). The flat bottomed configuration of the depressor weight made for safer deployment and retrieval of the sampling gear when the boat was rolling in rough seas. An electronic digital flowmeter was suspended within the mouth of each sampler to determine the amount of water filtered by each net in real time from on board the vessel. This was the first trial of these flowmeters on an ecosystem monitoring cruise. No flowmeters were used in the 20-cm bongos. The plankton sampling gear was deployed off the port side of the vessel using an A-frame and a conducting cable winch. After retrieval the bongo nets were washed down on a table set up near the A-frame to obtain the plankton samples. The 61-centimeter bongo plankton samples were preserved in a 5% solution of formalin in seawater. The CMarZ genetics samples and the Dave Richardson larval fish and egg samples were preserved in 95% ethanol, which was changed once 24 hours after the initial preservation. Tow depth was monitored in real time with a Seabird CTD profiler. The Seabird CTD profiler was hard-wired to the conductive towing cable, providing simultaneous depth, temperature, and salinity for each plankton tow. A CTD 9/11 Niskin bottle rosette sampler cast to within 5 meters of the bottom was made in Wilkinson, Jordan, and Georges Basins to provide hydrographic data from below the 200 m limit set for bongo tows. A CTD 9/11 Niskin bottle rosette sampler cast was also made at all the fixed stations to obtain a total of 116 water samples for nutrient analysis, as well as profiles of water temperatures, salinities, and chlorophyll-a and oxygen levels (Figure 3). A fluoroprobe unit was mounted on the array to provide data as to the type of algae present throughout the water column based on the fluorescence observed at different wavelengths and a Laser In-Situ Scattering and Transmissometry (LISST) instrument provided size spectrum analysis of suspended particles in the water column.

Tests of a Dave Richardson-modified Karatsuri sand lance rake were conducted during this cruise. This gear consisted of a weighted triangular iron frame trailing seven steel cables, each ending with a lead plug armed with several spikes protruding out at angles of 30 to 45 degrees from the central axis of the plug (Figure 4).

Continuous monitoring of the seawater salinity, temperature and chlorophyll-*a* level, and partial pressure of carbon dioxide (pCO<sub>2</sub>) from a depth of 3.7 meters along the entire cruise track was done by means of a thermosalinograph, a flow-through fluorometer and a pCO<sub>2</sub> system hooked up to the ship's scientific flow-through seawater system. The Scientific Computer System (SCS) recorded the output from both the thermosalinograph, and the fluorometer at 10-second intervals. The data records

were given a time-date stamp by the GPS unit.

## RESULTS

A summary of routine survey activities is presented in Table 1. Areal coverage for the cruise is shown in Figure 1. The NOAA vessel *GORDON GUNTER* sailed on Friday afternoon at 1300 hours EST, 28 February 2014, from its berth at Pier 2 of the Newport Naval Station and proceeded out to Georges Bank to take advantage of a favorable weather window of good sea conditions at that offshore area.

Starting at Great South Channel, the vessel worked east along the southern flank of Georges Bank towards the Northeast Peak, then west across the shoal area and finally east again along the northern flank Georges Bank and on into the Gulf of Maine. Figure 5 illustrates the track followed by the vessel until just before reaching Cape Cod Bay for the last stations. Good weather permitted several days of smooth progress on Georges Bank although increasing winds forced the dropping of two stations on the shallowest shoal area. Plankton catches on Georges Bank were low in biomass, and very few fish larvae or eggs were seen, until one station (35) on the northern edge of Georges Bank was found to have large numbers of fish eggs. After completing a station on the northern edge of Georges Bank the *GORDON GUNTER* headed towards the Northeast Channel and proceeded to sample the southeast corner of the Gulf of Maine and then north up the central Gulf of Maine, towards Jordan Basin. Stations in the northeast Gulf of Maine and near the Bay of Fundy were dropped due to time constraints. Plankton catches in the Gulf of Maine were even lower in biomass than those on Georges Bank. Forty nine ecosystem monitoring zooplankton samples and forty-nine ichthyoplankton samples were collected from the 61 cm bongo nets. Census of Marine Zooplankton (CMarZ) samples were collected at 6 randomly designated stations in the Georges Bank region, and 6 in the Gulf of Maine region, yielding a total of 12 samples using the 20-cm diameter bongo samplers as described above for this program.

A 20-cm bongo sampler equipped with 335 micron mesh nets was used to collect 24 ichthyoplankton samples for Dave Richardson from across the entire survey area.

The Dave Richardson-modified Karatsuri rake was deployed at three locations: two at the beginning of the cruise on the southwest corner of Georges Bank, and one on the last station of the cruise in Cape Cod Bay on Billingsgate Shoals. More deployments had been planned but were not undertaken due to marginal sea conditions at the sandier portions of Georges Bank. The rake did not catch any sand lance, but did pick up a number of invertebrates such as crabs, moon snails, clamshells and worms. The spines on the rake appeared to be the weak link of this gear. They were easily damaged and bent, even though the tows made in all cases did not exceed 5 minutes at the slowest possible ship speed of about one knot. Chris Taylor spent a great deal of time replacing and straightening spines to keep the gear functional through just three tows. Future versions of this gear might fare better with shorter and/or more robust spines.

Nineteen casts were made with the CTD 9/11 rosette array; seven of them on Georges Bank and twelve in the Gulf of Maine. The rosette array experienced some problems during the cruise. Cold temperatures caused the surgical rubber tubing inside the Niskin bottles to become slack and not seal the bottles well. This was corrected for this cruise by shortening the tubing, but all bottles will need new surgical tubing installed prior to future deployments. The CTD 9/11 unit failed during the coldest part of the cruise, but was replaced with a ship-owned unit. The Oceanography Branch unit was sent in for service after the cruise ended. The fluoroprobe unit mounted on the array did not function at all during the cruise, and will require service before being usable on future cruises. The

array-mounted LISST unit did work well and provided good data from the entire cruise. Several casts were made with a mesh bag attached to the rosette containing styrofoam cups decorated by students from the St. Joseph's School in Fairhaven, MA. These cups shrank, providing the students with souvenirs demonstrating the water pressures encountered at 300 to 500 meters depth (Figure 6).

The trial of the new electronic digital flowmeters went well. This was the first time we could get data on the net flow in real time on board the vessel during the tow. Unfortunately, the pulse converter module, which converts the pulses from the flowmeters into voltages that are recognized by the CTD unit, did not work properly for the ichthyoplankton net (6B3I). The other pulse converter module, on the zooplankton (6B3Z) net worked flawlessly. Repairs to the faulty module will be made after the cruise.

After the third and final test of the sand lance rake was made at Billingsgate Shoals, the *GORDON GUNTER* sailed back to the Newport Naval Station via the Cape Cod Canal, arriving there on Sunday morning, March 9, bringing the 2014 Winter Ecosystem Monitoring Cruise, GU1401, to a close.

## DISPOSITION OF SAMPLES AND DATA

All samples and data, except for the zooplankton genetics samples, the University of Maine nutrient samples, and the Seabird CTD data, were delivered to the Ecosystem Monitoring Group of the NEFSC, Narragansett, RI, for quality control processing and further analysis. The zooplankton genetics samples were delivered to Nancy Copley of the Woods Hole Oceanographic Institute. The nutrient samples were sent to Maura Thomas and Dave Townsend at the University of Maine. The CTD data were delivered to the Oceanography Branch of the NEFSC, Woods Hole, MA.

## SCIENTIFIC PERSONNEL

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Table 1. Summary of sample activities conducted at 60 stations at which the *GORDON GUNTER* stopped to lower instruments over the side during Cruise No. GU 1401. Latitude and Longitude are shown in decimal degrees. Std BON = 61 cm bongo Standard Protocol, CTD PROFILE 9/11 = fixed station, 2B3 = 333 mesh 20 cm bongo 2B1 = 165 mesh 20 cm bongo, RAKE=Sand lance rake, NUT=nutrients

CTD Cast#	SiteID/ STA#	Date GMT	Latitude (dd)	Longitude (dd)	Bottom Depth (m)	Operation
01	1	1 Mar	40.8967	-69.16	72	CTD PROFILE 911, NUT
	2	1 Mar	40.8283	-68.5083	58	RAKE
01	2	1 Mar	40.8283	-68.5083	58	Std BON/CTD, 2B3
02	3	1 Mar	40.6733	-68.7467	62	Std BON/CTD, 2B1
03	4	1 Mar	40.5917	-68.6783	62	Std BON/CTD, 2B1
---	5	1 Mar	40.6683	-68.4267	69	RAKE
04	5	1 Mar	40.6683	-68.4267	65	Std BON/CTD, 2B3
05	6	2 Mar	40.5095	-68.4147	96	Std BON/CTD, 2B1
06	7	2 Mar	40.3317	-67.9983	159	Std BON/CTD, 2B3
02	8	2 Mar	40.2467	-67.9983	1317	CTD PROFILE 911, NUT
03	9	2 Mar	40.375	-67.7033	227	CTD PROFILE 911, NUT
07	10	2 Mar	40.75	-68.0117	73	Std BON/CTD, 2B1
08	11	2 Mar	40.8383	-67.8333	66	Std BON/CTD, 2B3
04	12	2 Mar	40.9317	-67.71	63	CTD PROFILE 911, NUT
09	13	2 Mar	40.5	-67.2517	186	Std BON/CTD, 2B3
10	14	2 Mar	40.9083	-66.8433	90	Std BON/CTD, 2B1
11	15	2 Mar	41.08	-66.59	88	Std BON/CTD, 2B3
12	16	3 Mar	41.25	-66.4183	115	Std BON/CTD, 2B3
13	17	3 Mar	41.4117	-66.0867	143	Std BON/CTD, 2B3
14	18	3 Mar	41.655	-66.015	99	Std BON/CTD, 2B3
05	19	3 Mar	41.755	-65.435	1850	CTD PROFILE 911, NUT
15	20	3 Mar	41.8317	-65.7533	166	Std BON/CTD, 2B3
16	21	3 Mar	41.8267	-66.006	101	2B3 (sand in 6B nets)
17	21	3 Mar	41.8267	-66.015	95	Std BON/CTD
18	22	3 Mar	41.6617	-66.5	76	Std BON/CTD
19	23	3 Mar	41.4967	-66.8333	67	Std BON/CTD

Table 1. Summary of sample activities conducted at 60 stations at which the *GORDON GUNTER* stopped to lower instruments over the side during Cruise No. GU 1401. Latitude and Longitude are shown in decimal degrees. Std BON = 61 cm bongo Standard Protocol, CTD PROFILE 9/11 = fixed station, 2B3 = 333 mesh 20 cm bongo 2B1 = 165 mesh 20 cm bongo, RAKE=Sand lance rake

CTD Cast#	SiteID/ STA#	Date GMT	Latitude (dd)	Longitude (dd)	Bottom Depth (m)	Operation
20	24	4 Mar	41.345	-67.2567	48	Std BON/CTD
21	25	4 Mar	41.3617	-67.5133	38	Std BON/CTD
06	26	4 Mar	42.4733	-67.6867	44	CTD PROFILE 911, NUT
22	26	4 Mar	41.475	-67.6833	38	Std BON/CTD
23	27	4 Mar	41.165	-68	43	Std BON/CTD
24	28	4 Mar	41.2467	-68.1667	39	Std BON/CTD
25	29	4 Mar	41.2483	-68.255	50	Std BON/CTD
26	30	4 Mar	41.415	-68.4983	79	Std BON/CTD, 2B3
27	31	4 Mar	41.9883	-68.0933	222	Std BON/CTD, 2B3
07	32	4 Mar	42.0033	-67.6867	56	CTD PROFILE 911, NUT
28	33	4 Mar	41.9883	-67.58	45	Std BON/CTD
29	34	4 Mar	42.085	-67.585	167	Std BON/CTD, 2B1
30	35	5 Mar	42.0833	-66.9183	64	Std BON/CTD, 2B3
08	36	5 Mar	42.3767	-67.0450	344	CTD PROFILE 911, NUT
09	36	5 Mar	42.3750	-67.0450	344	CTD PROFILE 911, NUT
31	36	5 Mar	42.3745	-67.0567	340	nets tangled no sample
09	36	5 Mar	42.375	-67.045	344	CTD PROFILE 911, NUT
32	36	5 Mar	42.375	-67.0533	329	Std BON/CTD
33	37	5 Mar	42.4217	-66.7367	344	Std BON/CTD
34	37	5 Mar	42.4233	-66.7433	351	Seabird19 cal water sample
35	38	5 Mar	42.23	-65.7783	218	Std BON/CTD, 2B3
10	38	5 Mar	42.2267	-65.775	221	CTD PROFILE 911, NUT
36	39	5 Mar	42.4983	-65.9283	129	Std BON/CTD, 2B1
12	41	5 Mar	43.0267	-66.3417	139	CTD PROFILE 911, NUT
37	41	5 Mar	43.025	-66.33	122	Std BON/CTD
38	42	5 Mar	42.8317	-66.9983	197	Std BON/CTD, 2B1
39	43	6 Mar	42.7083	-67.7133	187	Std BON/CTD
40	44	6 Mar	43.4017	-67.6983	245	Std BON/CTD, 2B3
41	44	6 Mar	44.19	-67.7017	238	Seabird19 vertical cast
42	45	6 Mar	44.1965	-67.7002	190	Hit bottom will repeat tow
43	45	6 Mar	44.1895	-67.7002	178	Std BON/CTD
14	45	6 Mar	44.1945	-67.0793	177	CTD PROFILE 911, NUT
44	46	7 Mar	43.77	-68.6667	112	Std BON/CTD, 2B1

Table 1. Summary of sample activities conducted at 60 stations at which the *GORDON GUNTER* stopped to lower instruments over the side during Cruise No. GU 1401. Latitude and Longitude are shown in decimal degrees. Std BON = 61 cm bongo Standard Protocol, CTD PROFILE 9/11 = fixed station, 2B3 = 333 mesh 20 cm bongo 2B1 = 165 mesh 20 cm bongo, RAKE=Sand lance rake

CTD Cast#	SiteID/ STA#	Date GMT	Latitude (dd)	Longitude (dd)	Bottom Depth (m)	Operation
15	47	7 Mar	43.7705	-68.6663	110	CTD PROFILE 911, NUT
45	48	7 Mar				Wire jam no tow
46	48	7 Mar	42.92	-68.7467	204	Std BON/CTD, 2B1
47	49	7 Mar				CTD failure
48	49	7 Mar	42.8317	-69.16	163	Std BON/CTD, 2B3
49	50	7 Mar	42.8267	-69.405	143	Std BON/CTD, 2B1
50	51	7 Mar	42.7533	-69.4983	193	Std BON/CTD, 2B3
51	52	7 Mar	42.749	-69.4958	204	Hit bottom sand in nets
52	52	7 Mar	42.7533	-69.4977	198	Std BON/CTD, 2B3
16	53	7 Mar	42.5048	-69.6657	255	CTD PROFILE 911, NUT
53	53	7 Mar	42.4983	-69.6633	250	Std BON/CTD, 2B3
17	54	8 Mar	42.4183	-70.6267	79	CTD PROFILE 911, NUT
54	54	8 Mar	42.42	-70.6267	80	Std BON/CTD, 2B3
18	55	8 Mar	42.3617	-70.4667	73	CTD PROFILE 911, NUT
19	56	8 Mar	42.315	-70.2833	33	CTD PROFILE 911, NUT
55	57	8 Mar	42.25	-70.015	136	Std BON/CTD, 2B3
56	58	8 Mar	42.2483	-70.2517	29	Std BON/CTD, 2B3
57	59	8 Mar	41.9967	-70.51	34	Std BON/CTD, 2B3
	60	8 Mar	41.8467	-70.1322	22	RAKE on Billingsgate Shoals

**TOTALS:**    *Std/BON/CTD Casts*                    =    **49**  
                   *2B3 Bongo Casts*                        =    **23**  
                   *2B1 Bongo Casts*                        =    **11**  
                   *CTD PROFILE 911 Casts*                =    **18**  
                   *Nutrient Casts*                            =    **18**  
                   *Sand lance rake tows*                    =    **3**

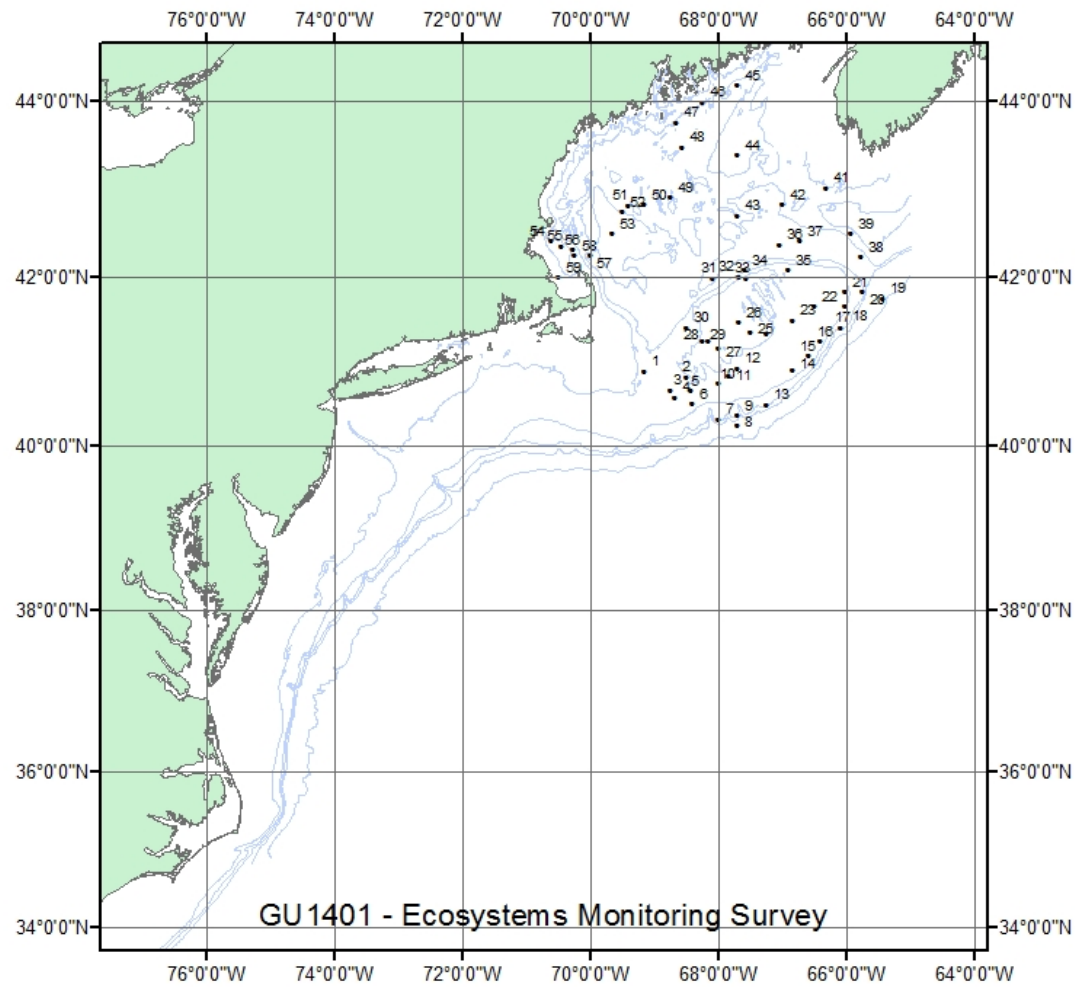


Figure 1. Station locations numbered consecutively for Winter Ecosystem Monitoring Survey GU 1401, 28 February to 9 March, 2014.

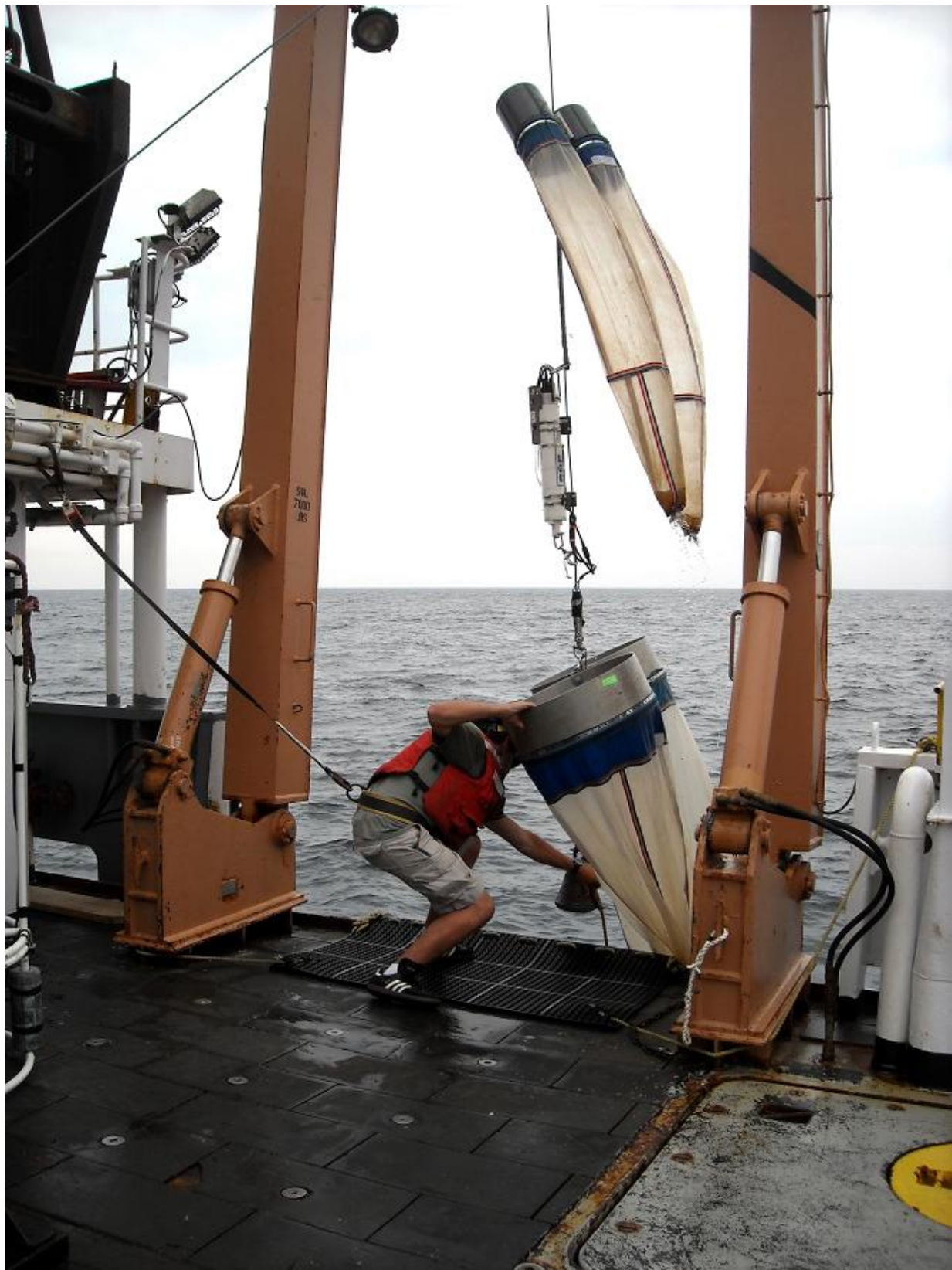


Figure 2. Bongo net array, showing 61 and 20 cm bongo nets, CTD unit and depressor weight. (Note this photo taken aboard the *DELAWARE II*).



Figure 3. Niskin bottle and CTD 9/11 array being retrieved onto *GORDON GUNTER*.

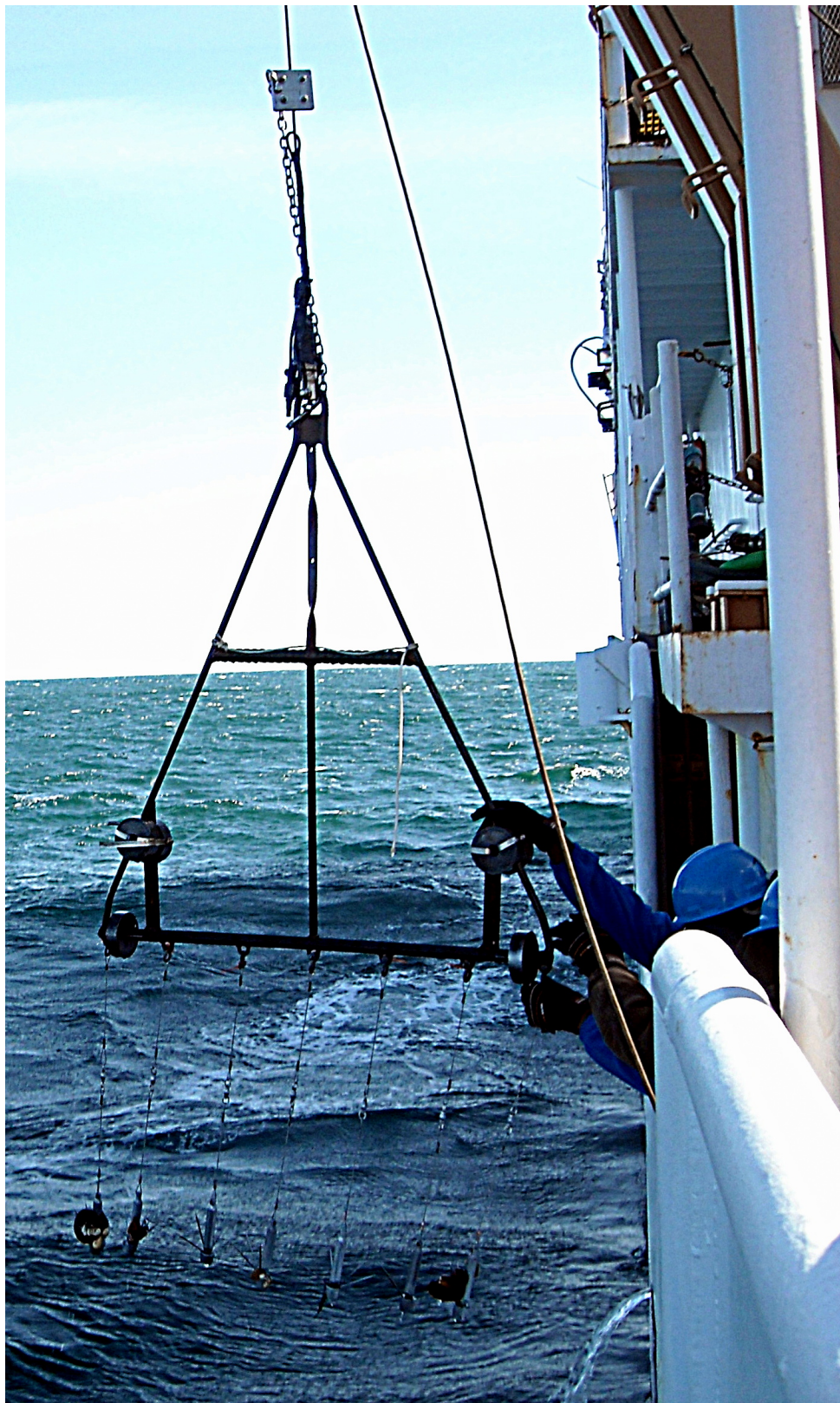


Figure 4. The Dave Richardson-modified Karatsuri Rake being retrieved on the GORDON GUNTER. Note the invertebrates captured on the collecting spikes.

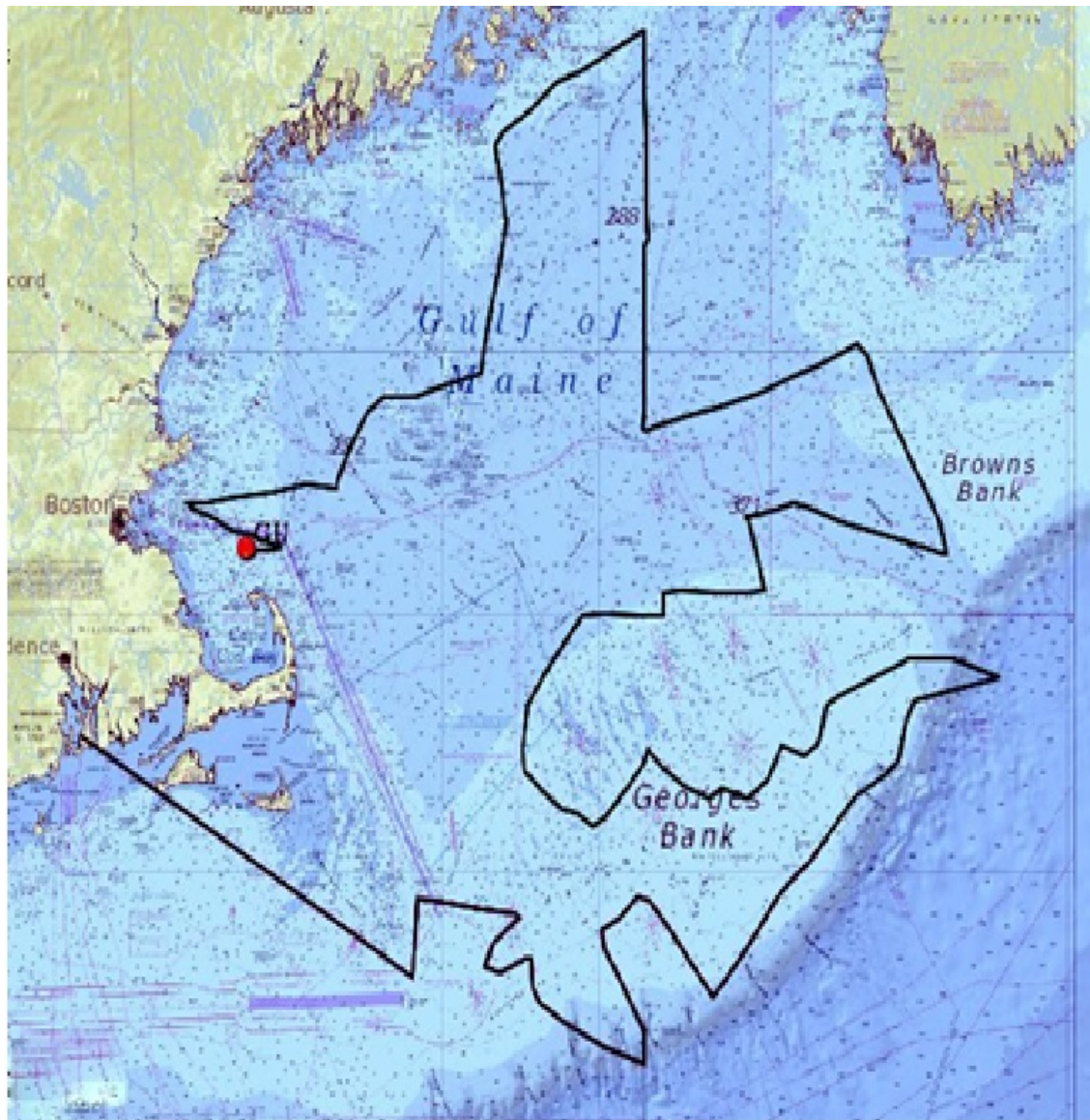


Figure 5. GU 1401 cruise track across Georges Bank and the Gulf of Maine, prior to arriving at Cape Cod Bay.



Figure 6. Mesh bag attached to rosette containing styrofoam cups decorated by students for water pressure demonstration on GU 1401 cruise.

## Appendix 1. Marine Mammal and Seabird Observations

### GENERAL RESULTS FROM 2014 WINTER SURVEY ON THE GORDON GUNTER VESSEL.

See Gjerdrum *et al* (2012) for further information on seabird at-sea survey rationale and survey protocol.

These surveys occurred from 28 February – 9 March. During this 10 day period a total of 848 birds and 113 marine mammals were encountered.

The most abundant bird species observed during the trip were Dovekie (18,16% of 848), Northern Fulmar (14,15%) and Black-legged Kittiwake (14,03%), respectively. The most abundant marine mammals were Common Dolphin (43,36% of 113), Long-finned Pilot Whale (35,40%) and North Atlantic Right Whale (5,31%). During this survey, Northern Gannet accounted for 12,85% of bird observations. Individuals from 14 other bird species were recorded but were observed less frequently on this mission. Four others marine mammal species were observed. 11 pieces of floating debris or garbage were recorded during the mission. Refer to Tables 1 and 2, presented below, for additional information.

### ACKNOWLEDGEMENTS

I would like to thank personally EC CWS and NOAA for making this survey possible. In particular, I would like to thank scientists, staff and officers aboard the Gordon Gunter Vessel for another truly rewarding and memorable experience.

Table 1. Numbers of birds observed during winter 2014 aboard the Gordon Gunter vessel.

Name	March, 2014	%
alcid sp (unknown alcid)	3	0,35
Northern Gannet	109	12,85
Northern Fulmar	120	14,15
Iceland Gull	1	0,12
Herring Gull	23	2,71
Great Black-backed Gull	44	5,19
gull sp (unknown gull)	2	0,24
Great Cormorant	20	2,36
Great Skua	1	0,12
Thick-billed Murre	17	2,00
Common Murre	30	3,54
unknown murre or Razorbill	5	0,59
murre sp (unknown murre)	3	0,35
Long-tailed Duck	15	1,77
White-winged Scoter	17	2,00
Surf Scoter	47	5,54
Atlantic Puffin	36	4,25
Dovekie	154	18,16
Bonaparte's Gull	39	4,60
Black-legged Kittiwake	119	14,03
bird sp (unknown bird)	38	4,48
Razorbill	2	0,24
Common Loon	2	0,24
loon sp (unknown loon)	1	0,12
<b>Total</b>	<b>848</b>	<b>100,00</b>

Table 2. Numbers of marine mammals observed during winter 2014 aboard the Gordon Gunter vessel.

<b>English Name</b>	<b>Number</b>	
	<b>indv</b>	<b>%</b>
Fin Whale	3	2,65
Harbour Seal / Common Seal	1	0,88
Grey Seal	2	1,77
Humpback Whale	5	4,42
whale sp (unknown whale)	7	6,19
North Atlantic Right Whale	6	5,31
Common Dolphin	49	43,36
Long-finned Pilot Whale	40	35,40
<b>Total</b>	<b>113</b>	<b>100,00</b>

## RÉFÉRENCE

Gjerdrum, C., D.A. Fifield, S.I. Wilhelm. 2012. Protocole normalisé pour les relevés d'oiseaux marins pélagiques dans l'Est du Canada (Eastern Canada Seabirds at Sea; ECSAS) à partir de plateformes mobiles et stationnaires. Série de rapports techniques du Service canadien de la faune no 515. Région de l'Atlantique. vii + 41 p.